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A METHODOLOGY FOR ANALYZING CONGRESSIONAL BEHAVIOR TOWARD DEPARTMENT OF DEFENSE BUDGET REQUESTS

Joseph Garside Terry

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THESIS

A METHODOLOGY FOR ANALYZING CONGRESSIONAL BEHAVIOR TOWARD DEPARTMENT OF DEFENSE BUDGET REQUESTS

by

Joseph Garside Terry, Jr.

Thesis Advisor: J. R. Capra

September 1973

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A Methodology for Analyzing Congressional Behavior Toward Department of Defense Budget Requests

by

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B.S., United States Military Academy, 1967

Submitted in partial fulfillment of the
requirements for the degree of

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ABSTRACT

A methodology based on the current Department of Defense budgetary process and recent efforts to model federal budgetary behavior is proposed for analyzing Congresional behavior toward Department of Defense budget requests. Four simple, linear, stochastic models which associate Congressional appropriations and DOD budget requests are suggested and empirically tested via a cross-sectional regression analysis for Procurement and Research, Development, Test and Evaluation in the 1970-1973 time frame. Results of the tests are tabulated and discussed. Model strengths as well as weaknesses are evaluated based on proportional and absolute measures of model fit to the data. Areas for further analysis are also suggested.

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I. INTRODUCTION

The Vietnam conflict and growing concern over dwindling resources have aroused public and Congressional interest in Department of Defense (DOD) expenditures. The analysis presented in this thesis was suggested by this interest. Analysis focuses on the interaction between Congress and the Department of Defense in the federal budgetary process. Specific effort is made to explain Congressional behavior by evaluating four simple models which relate Congressional appropriations and DOD budget requests.

In recent studies of the federal budgetary process, Richard F. Fenno, Aaron Wildavsky, and the team of Demptster, Davis, and Wildavsky have established themselves as leaders in the study of the Congressional aspects of federal budgetary behavior. Fenno and Wildavsky are noted for their painstaking efforts in documenting Congressional appropriation procedures and personalities; and Dempster, Davis, and Wildavsky are recognized for expanding this verbal documentation and proposing a series of simple, linear, stochastic models to empirically test the hypothesis that federal budgetary processes can be modeled by simple (basically incremental), linear decision rules which are stable over time and applicable to a wide variety of institutions. In a series of reports in a continuing study, Dempster, Davis, and Wildavsky have focused their attention on time-series

analysis of both agency and Congressional behavior for selected non-defense federal agencies over a period of approximately 16 years (1947-1963). The data used was taken from records of agency requests and Congressional appropriations based on those requests.

Noticeably, Dempster, Davis, and Wildavsky have thus far failed to consider the Department of Defense in their data base although they have acknowledged that there is no reason to believe that their methods would not be equally applicable to DOD [Ref. 2, p. 301]. While there has been no documented attempt to apply Dempster, Davis, and Wildavsky's ideas to DOD, Arnold Kanter has studied Congressional changes in DOD budget requests and concluded that Congress is concerned foremost with national security objectives in its appropriation action; and John Crecine and Greg Fischer have attempted to model resource allocation within DOD via a number of simple interactive, linear models, while stresing the importance of macroeconomics and the overriding bureaucratic factors in determining DOD expenditures.

The purpose of this thesis is to suggest, express mathematically, and empirically test four simple, linear, stochastic models which seek to explain Congressional behavior (manifested by an appropriation) toward the President's Defense budget requests. These models are in fact an effort to mathematically express the verbal theories of Wildavsky and Fenno and are in the tradition of Dempster, Davis, and Wildavksy's work with non-defense agencies.

The actual organization of the analysis includes background on the defense budget process and a detailed discussion of the methodology used in specifying the models. In this background and discussion, effort is made to identify possible roles and impacts of Congress in the overall budget process. These sections are followed by a chapter on collecting appropriate data and empirically testing the suggested models. This is followed by a comprehensive report of the empirical results. Finally, analysis and significance of the empirical results are discussed and possible areas for further analysis are suggested.

II. MODEL DESIGN

A. BACKGROUND

This section will cover background material on the place of Congress and the Defense Department in the defense budget cycle. A detailed chronology of the defense budget will be given which, at its end, will suggest the possible operation of simple decision rules during various points of the process. Current literature on federal budgetary behavior is then surveyed. The verbal theories of Wildavsky and Fenno are described and the notion of simple decision rules to describe budget processes is reinforced by evidence of the use of base figures and incrementalism in Congressional action on budget requests. Finally, four mathematical models are formulated which are consistent with the evidence of simple decision rules presented in the detailed chronology and the federal budgetary literature survey.

1. Congress, Defense Department and the Budget Cycle

Philosophically, "budgeting deals with the purposes of men"; more pointedly, the budget was described by Wildavsky as "a link between financial resources and human behavior to accomplish policy objectives" [Ref. 26, p. 1]. In the process of allocating resources, a budget becomes a mechanism for making choices among alternative expenditures. In terms of Department of Defense budget requests, if interactions among constrained objectives, substitutive programs,

and contradicting feelings within DOD and Congress are regarded as conflict, then, in Wildavsky's words, "the budget records the outcomes of this struggle" [Ref. 26, p. 4].

The Department of Defense (DOD) budgeting cycle can be viewed as a chronological sequence of events in which a continuous interaction among the major participants (i.e. DOD, Congress, and the President) occurs. The actual sequence involves a preparation phase (within DOD but with Presidential fiscal guidance and final budget approval), Congressional review and appropriation, final DOD resource allocation, and audit. The formal chronological sequence provides structure to the budgetary cycle but does not reveal the informal structure or decision process which the interaction among participants reveals. While the chronology sequences those events which might shape Congressional behavior, interaction among the participants (primarily DOD and Congress) in this flow emphasizes the continuous nature of Congressional appropriation behavior. This behavior is evident in accepted roles and expectations of DOD (as an Agency) and Congress.

In the formulation of any models to explain collective Congressional behavior toward DOD budget request, it is important to understand when DOD and Congress appear explicitly in the chronology. It is also important to identify the possible impact of interaction between Congress and DOD throughout the entire budget process.

However, it is also important at this point to note that this analysis only specifically studied Congresional

behavior from the time of budget submission to actual appropriation. Whereas it is reasonable to believe that the entire budget cycle might impact on Congressional appropriation behavior and to formulate models accordingly, only the actual flow of the budget request through the relevant House and Senate Authorization and Appropriation Committees and accompanying interaction between DOD and those committees was considered in the formulation and testing of the models used in this analysis of Congressional appropriation behavior.

2. Chronology of the Defense Budget Process

Congress appears in the middle, so to speak, of the chronological sequence of DOD budgeting. Prior to budget request submission to Congress, the DOD budget has undergone a formal 18-month preparation cycle of planning, programming, and budgeting within DOD (referred to as the Planning, Programming, and Budgeting System). The planning cycle is approximately six months long and primarily involves threat analysis dialogue and eventual consensus among the Secretary of Defense, National Security Council, and the Joint Chiefs of the Army, Navy, Marine Corps, and Air Force. The programming cycle is nine months. This cycle involves a dialogue betwen Service Chiefs and the Office of the Secretary of Defense (OSD). Key documents are exchanged, reviewed, and commented upon and at the end of the cycle OSD publishes Program Decision Memos which assimilate all relevant opinions and approves the various force levels, weapons systems, and

resources needed in the next five years to meet agreed upon threats. The budgeting cycle follows in the next three months and involves "crosswalking" (transforming) program budget requests (in terms of outputs, i.e., force levels, weapons systems, etc.) into Congressional budget appropriations categories (in terms of inputs, e.g. for the Navy, Manpower (MPN), Operations and Maintenance (OMN), Procurement Air and Missile (PAMN), Ship Construction (SCN), Other Procurement (OPN), and Research, Development, Test and Evaluation (RDTE)) for the current five year program. The first year of this "crosswalked" five year plan is then "peeled off" and submitted to Congress for appropriations action.

If interest were focused on the fiscal year 1974 DOD budget, then the PPB cycle would have begun in June, 1971 and terminated in January, 1973 with budget submission to Congress. Congress, then, in six months must review and appropriate funds based on the submitted budget. In actuality, the procedure may take considerably longer since the final Defense Appropriation Bill is the result of a complex path of authorization and appropriation action which calls for separate House and Senate action. In each case where the House and Senate cannot reach a consensus, conference action is required to effect compromise. The procedure is highlighted by the passage of a Defense Authorization Bill for Procurement and RDTE which is the primary responsibility of the House and Senate Armed Service Committees and finally

the Defense Appropriation Bill which is the primary responsibility of the Defense Appropriations Subcommittees of the House and Senate Appropriations Committees. Each step in the movement of a DOD budget request through the Congress is part of a sequence, the components of which constrain or limit the final appropriation action. For example, the budget request first goes to the House Armed Services Committee where upper bounds can be set for final appropriation action.[1] A similar upper bound is given by the Senate Armed Services Committee. If, after floor action, the two upper bounds do not agree, the difference is settled in a joint conference session. The resulting authorization bill (reported concurrence from the House and Senate that an amount not to exceed a stated upper bound can be appropriated for each of the military service budget requests) is then passed to the respective House and Senate Appropriations Subcommittees on DOD where a similar process takes place.

The final Department of Defense Appropriation Bill reflects a new obligational authority (NOA) for each budget request. This NOA allows DOD to sign contracts for the amount of the NOA at any time during the obligational period associated with the budget category. For example, Manpower and Operations and Maintenance are one-year periods, while

---

[1] MPN and OMN are not considered by either the House or Senate Armed Services Committee.

Procurement Air and Missile is three, Ship Building and Conversion Five, and Research, Development, Test and Evaluation two years.

The approved budget is then given back to DOD where the Services actually allocate resources. In this pahse, the budget is "crosswalked" back to program categories and resources are allocated to programs. In this pahse, DOD is also allowed to reprogram (or rechannel some of its funds into other programs) subject to certain constraints [Ref. 21]. Record is kept of resource allocation and reprogramming by Congressional budget categories. These records are summarized semiannually and the summaries are sent to Congressional committees for use in budgeting authorization or appropriation decisions. These documents are also available to OSD and the General Accounting Office for audit of ongoing service programs.

The chronological sequence just discussed structures the DOD budgeting process and to a certain extent gives evidence of how that structure may affect Congressional behavior toward a DOD budget request.

From this annual, regualr sequence of events, it is reasonable to suggest a simple model (or series of models) using reported appropriations and budget requests which attempt to explain Congressional behavior toward approved budget requests. Yet, as previously stated, this sequence might not reveal the informal structure or decision process which is continuously evident in interaction between Congress

and DOD throughout the budgeting process. There is evidence available in documented observations of this interaction (primarily by Fenno and Wildavsky) to reinforce a simple model approach to collective Congressional budgetary behavior. Before formulating the models actually used, it is essential to describe these observed interactions and related verbal theories.

B. BUDGETING LITERATURE

The works of Wildavsky (The Theory of the Budgetary Process) and Fenno (The Power of the Purse) represent current theory on federal budgetary behavior. Both works were based on numerous interviews of both Agency and Congressional officials and years of observing Congressional appropriations action. This small section will discuss documented Congressional/Agency effort to eliminate uncertainty in their budget interactions and evidence of Congressional use of base figures and incrementalism in determining appropriations.

The complexities of Congressional/DOD interaction are well known and openly admitted. George H. Mahon, Chairman of the Subcommittee on Department of Defense, Committee on Appropriations, House of Representatives stated:

> No human being regardless of his position and capacity could possibly be completely familiar with all the items of appropriations contained in a defense bill [Ref. 26, p. 10].

While a member of the same subcommittee, former Secretary Laird said, "A lot of things go on in this subcommittee that

I cannot understand" [Ref. 26, p. 9]. Since this interaction takes place in a complex, dynamic, and often turbulent environment, the models to be suggested later share a fundamental assumption that individuals and organizations when operating in this environment will actively seek to eliminate uncertainty wherever possible. Adjustment or adaptation to this environmental field is predicated on two mechanisms which Cyert and March observed by which organizations attempt to reduce uncertainty. First, organizations avoid the uncertainty of long-range planning by relying on short-run reaction to feedback from the environment (this mechanism makes sense only if the environment can be assumed stable in the short-run). And secondly, organizations attempt to arrange a negotiated environment or at least a receptive or predictive one [Ref. 16, p. 6].

This shared assumption that participants in a complex, dynamic environment will actively seek to eliminate uncertainty by creating a stable, predictive environment has been observed by Wildavsky and Fenno as fundamental in Congress/Agency budget interactions. Fenno, in The Power of the Purse, stated the problem and observed solution this way:

> Agency officials feel they cannot be sure what the committee will do: committee members feel they cannot be sure they have the information they need. Both seek increased certainty. [Ref. 13, p. 320, underline added for emphasis]

Fenno consolidates his observations on the behavior of the participants into expectations or roles of agencies and committees with respect to each other. Agency expectations toward committees were of two sorts: those pertaining to substantive goals and those pertaining primarily to the maintenance of a stable relationship between the two groups [Ref. 13, p. 266]. One of the maintenance expectations of the agency appeared to be a desire for a high degree of predictability or certainty in its committee relations [Ref. 13, p. 273]. Also agencies believed that committees should follow fair procedures in dealing with them. The Congressional Appropriations Committee members, as noted by Fenno, believed in their agency interaction that the agency be "frank and open and should not attempt to cover-up or hold back relevant information" [Ref. 13, p. 320].

With these observations of Congressional roles and their impact on DOD budgeting in mind, it is not unreasonable to hypothesize that Congressional behavior might be explained by a model (or series of models) that was simple and stable over time. Further, it will be shown it is also reasonable to hypothesize that this model might be linear. This simplistic approach has been substantiated by evidence (which follows in the next paragraph) that Congress uses a base figure (for each agency) and appropriates funds according to some incremental increase or decrease in that figure. Such incrementalism suggests a possible percentage

argument which is very appealing to both common sense and the linear modeling assumption.

Wildavsky, in The Politics of the Budgetary Process, defined a base as "the general expectation among participants that programs will be carried on at close to the going level of expenditures but it does not necessarily include all activities" [Ref. 26, p. 17]. Fenno noted that agency expectations are that the Appropriations Committees will accept its "base" (core program) and focus decision-making on the increment being requested. Also, Fenno observed the Appropriation Committees to perceive their oversight and budget-reducing tasks as essentially incremental operations. He further stated:

> Just as the agency considers much of its request to be beyond controversy, so too does the Committee act on this assumption by restricting its purview to those budgetary increments granted in the previous year and requested for the coming year [Ref. 13, p. 318].

Although the research of Fenno and Wildavsky involved non-defense agencies, they were attempting to make general statements concerning Congressional appropriation behavior. This idea is supported by the fact that most Defense Subcommittee members also sit on non-defense subcommittees. Hence, it is not unreasonable to attempt to extend the ideas of Fenno and Wildavsky to DOD appropriations.

C. MODEL SPECIFICATION

Realizing the relative position and impact of Congress on the DOD budgeting process and drawing upon evidence gathered by Wildavsky and Fenno that Agency/Congress budget rules might be simple and stable over time, four models were suggested to explain Congressional behavior in regard to DOD budget requests. These models were all linear and involved postulated relationships among Congressional appropriations and budget requests. In each model, the constant term normally seen in a linear model was suppressed in order to interpret each coefficient as a percentage figure. Although intuitively appealing, this idea did present some difficulty in the empirical testing and evaluation of the models later in the analysis. In addition, each model contained a random disturbance element which accounted for events which might upset the simplicity and linearity of the models or in some way affect the inherent stability in the modeled budget process. Such events would be exogenous to the budget process and would include international events, administration changes, or indications of strong public opinion in a particular area.

In each model, the variables had the following meaning:

Y_t - current year Congressional appropriation (a final figure which includes all relevant House and Senate authorization and appropriation action on the request)

X_t - current year appropriation request (approved by the President)

Y_{t-1} - previous year Congressional appropriation (except in noted cases where current year program[2] was used as a substitute for previous year appropriation)

X_{t-1} - previous year appropriation request (except in noted cases where previous year authorization was used as a substitute for previous year appropriation request)

The models are as follows:

MODEL A: $Y_t = B_1 X_t + \varepsilon$

This model states that the current year appropriation is a percentage of the current year request plus a random disturbance.

MODEL B: $Y_t = B_1 Y_{t-1} + B_2(X_t - B_1 Y_{t-1}) + \varepsilon$

This model states that the current year appropriation is a percentage of last year's appropriation (which constitutes a "base" figure) plus a percentage of the difference between this years request and the "base" figure plus a random disturbance.

MODEL C: $Y_t = B_1 X_{t-1} + B_2(X_t - B_1 X_{t-1}) + \varepsilon$

---

[2] Current year program with reprogramming modifications included

This model states that the current year appropriation is a percentage of last years request (which constitutes a "base" figure) plus a percentage of the difference between this years request and the "base" figure plus a random disturbance.

MODEL D: $Y_t = B_1 Y_{t-1} + \varepsilon$

This model states that the current year appropriation is a percentage of last years appropriation plus a random disturbance. (This model was suggested by a high correlation between current year and previous year appropriation noticed in testing Models A, B, and C.)

It should be noted that these models suppress any difference in the outlook of House and Senate Armed Services Committees or Appropriations Committees. In the variable Y_t, the models have aggregated authorization action (committee, floor, and conference action) and appropriation action (committee, floor, and conference action). For studies of the differences between House and Senate appropriations actions see Fenno [Ref. 13] and Kanter [Ref. 17].

All models, especially A and D, reflect incremental behavior on the part of Congress. This view is consistent with the presence of incrementalism observed by Wildavsky and Fenno. Models B and C primarily reflect a base concept (i.e. $B_1 Y_{t-1}$ and $B_1 X_{t-1}$ for Models B and C respectively) which again is consistent with observations of Congressional

budgetary behavior by Wildavsky and Fenno. All models are consistent with the idea of simple decision rules suggested first in the detailed chronology of the DOD budget process and later in the survey of federal budgetary literature.

III. EMPIRICAL TESTING

Before actually selecting a data base for testing the models, recent (1950-1973) aggregations of Congressional change to DOD budget requests were studied to isolate (if possible) a time period (or periods) when Congressional change to requests was highest. It appears that the 1969-1973 time period reflected the greatest Congressional change to DOD budget requests [Ref. 18, p. 5]. During this period (notably linked with administration changes in the White House and DOD and national discontent), Congressional change averaged 5.6% while the average prior to those years (from 1950) was barely over 2.2% [Ref. 18]. Also, changes in Procurement and RDTE during this period averaged better than 12% and 7% respectively, while Personnel and Operations and Maintenance averaged less than 2% and 3% respectively. While these figures are a practical justification for this entire analysis, they also greatly aided in determining an appropriate data base for testing the suggested models.

Fenno in The Power of the Purse suggested that any Congressional change less than 5% was of marginal use in analyzing Congressional appropriation behavior [Ref. 13, p. 353]. Using this criteria, attention was narrowed to Procurement and RDTE budget requests and appropriations in the 1969-1973 time frame.

In order to empirically test the four models presented in the preceding chapter, a data base that included at least current year appropriation and request was needed.

The data sources available were spread sheets used by the Senate Committee on Armed Services (printed by the Committee) [Ref. 24], summary tables prepared by Services in Hearings before Senate and House Subcommittees on Appropriations [Ref. 6,7], summaries of DOD reprogramming changes reflected in DD1416 (printed by the Comptroller Office of the Department of the Navy) [Ref. 20], and summaries of Congressional Action by Appropriate Title and Item (printed by Comptroller OSD) [Ref. 3]. These documents reflected basic budget categories and their activities; and included at least requests and appropriations for the current fiscal year. Senate Armed Services Committee spread sheets, reported the desired Procurement and Research, Development, Test and Evaluation (RDTE) budget categories. Because of a multitude of format changes in DOD budget requests and Congressional authorization and appropriation categories, aggregations of reported requests and appropriations were frequently inconsistent over time. For example, fiscal year 1973 Procurement spread sheets reflected Torpedoes as a separate budget category for the first time (prior to then, torpedoes were part of Ammunition Procurement). Activities within categories have also frequently changed. RDTE 1971 reflected 12 more activities under Military Sciences - Army than RDTE 1973; and even among the nine which were similar in code number there were noted differences in word descriptions of the codes [Ref. 24]. Certain data was also inaccessible

because of security classification and administration peculiarities within Congress and the Office of the Secretary of Defense (OSD). While these deficiencies posed certain analytical difficulties and constraints (chiefly the preclusion of a time-series analysis), the data did present an accurate report, as determined by cross-referencing, of Congressional appropriations and DOD requests in the 1970-1973 time frame. Sufficient detail was available to accomplish a cross-sectional analysis on selected accounts within the Procurement and RDTE categories of DOD appropriations.

Because of the accepted importance of committee and subcommittee action in determining appropriations, spread sheets printed by the Senate Armed Services Committee and those tables listed in reports of the Defense Appropriations Subcommittee Hearings were studied in detail to determine an appropriate aggregation level for testing the models. Both documents reflected three major data aggregation divisions:

1. Major Category (e.g. Procurement
   - Army
   - Navy
   - Air Force
   - Marines

   RDTE
   - Army
   - Navy
   - Air Force
   - Marines
2. Sub-Categories (e.g. Procurement
   - Aircraft
     - Army
     - Navy
     - Air Force
     - Marines

Missiles
  Army
  Navy
  Air Force
  Marines
Other sub-categories

3. Activities (e.g. Procurement
    Aircraft
      Army
        CH-47
        Cobra Helicopter
        Observation Helicopter
        Others

The Sub-Categories level was chosen as the appropriate account level of analysis. These categories, particularly within RDTE, seemed most stable over time and were neatly summarized on one page of the Committee spread sheets for easy reference of committee members [Ref. 24]. In addition, these categories represented the last categorical division before a detailed listing of activities within the sub-category. Given competing demands of activities in a sub-category and Congressional time constraints, the Sub-category level seemed the best level of aggregation (account level) for analyzing Congressional appropriation behavior toward DOD budget requests at the account level, especially when testing simple linear models.

With this concept of a DOD account, Procurement and RDTE were analyzed separately for each year sufficient data was available. Categories which comprised the respective data bases of Procurement and RDTE are listed in Figure III-1 and III-2. Data was taken from Committee spread sheets and tabulated for testing each model (see Appendix A for data summaries).

FIGURE III-1

Procurement	
Aircraft	
Army	(1)
Navy and Marine Corps	(2)
Air Force	(3)
Missiles	
Army	(4)
Navy	(5)
Marine Corps	(6)
Air Force	(7)
Navy Vessels	(8)
Tracked Combat Vehicles	
Army	(9)
Marine Corps	(10)
Other Weapons[1]	
Army	(11)
Navy	(12)
Marine Corps	(13)
Torpedoes[2]	(14)

[1] Category initiated in 1971

[2] Category initiated in 1973

FIGURE III-2

Research, Development, Test, and Evaluation	
Army	
Military Sciences	(1)
Aircraft and Related Equipment	(2)
Missiles and Related Equipment	(3)
Military Astronautics	(4)
Ordnance, Combat Vehicles, and Related Equipment	(5)
Other Equipment	(6)
Programwide Management and Support	(7)
Navy	
Military Sciences	(8)
Aircraft and Related Equipment	(9)
Missiles and Related Equipment	(10)
Military Astronautics	(11)
Ships and Small Craft Related Equipment	(12)
Ordnance, Combat Vehicles, and Related Equipment	(13)
Other Equipment	(14)
Programwide Management and Support	(15)
Air Force	
Military Sciences	(16)
Aircraft and Related Equipment	(17)
Missiles and Related Equipment	(18)
Military Astronautics	(19)
Ordnance, Combat Vehicles, and Related Equipment	(20)
Other Equipment	(21)
Programwide Management and Support	(22)
Defense Agencies[1]	
Military Science	(23)
Missiles and Related Equipment	(24)
Other Equipment	(25)
SADA	(26)
ARPA	(27)
DASA	(28)
Other	(29)

[1] Categories in this area vary considerably from year to year; categories listed appear to be the most stable and representative since 1969.

Prior to regression analysis, plots were made of current year appropriations vs current year request, prior year request, and prior year appropriation to get a relative feel for the validity of assuming linear models and further, to gain a general idea of the impact of suppressing the constant term in the fit of the data to a line. The plots (see Figure III-3 and III-4 for Procurement and RDTE 1971) revealed a strong linear relationship between current year appropriation and current year budget request and also a strong indication that the constant term (if included in the analysis) would have little impact on the true line fit to the data. Also, possible heteroscedastic bias (relationship of the magnitude of the residuals to the magnitude of the independent variables) was examined since the data analysis is confined to the 1st quadrant (i.e. the smaller the value of the independent variable the smaller the value of the residual). This potential problem was further investigated in a graphical study of residuals vs current year appropriation, previous year appropriation, current year request, and previous year request when each model was tested.[1]

Multiple linear regression analysis was then used to test the four suggested models with the appropriate accumulated data. The BIOMED series of statistical programs on

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[1] No significant patterns of residuals were noted but further analysis is needed in this area.

FIGURE III-3

PROCUREMENT 1971

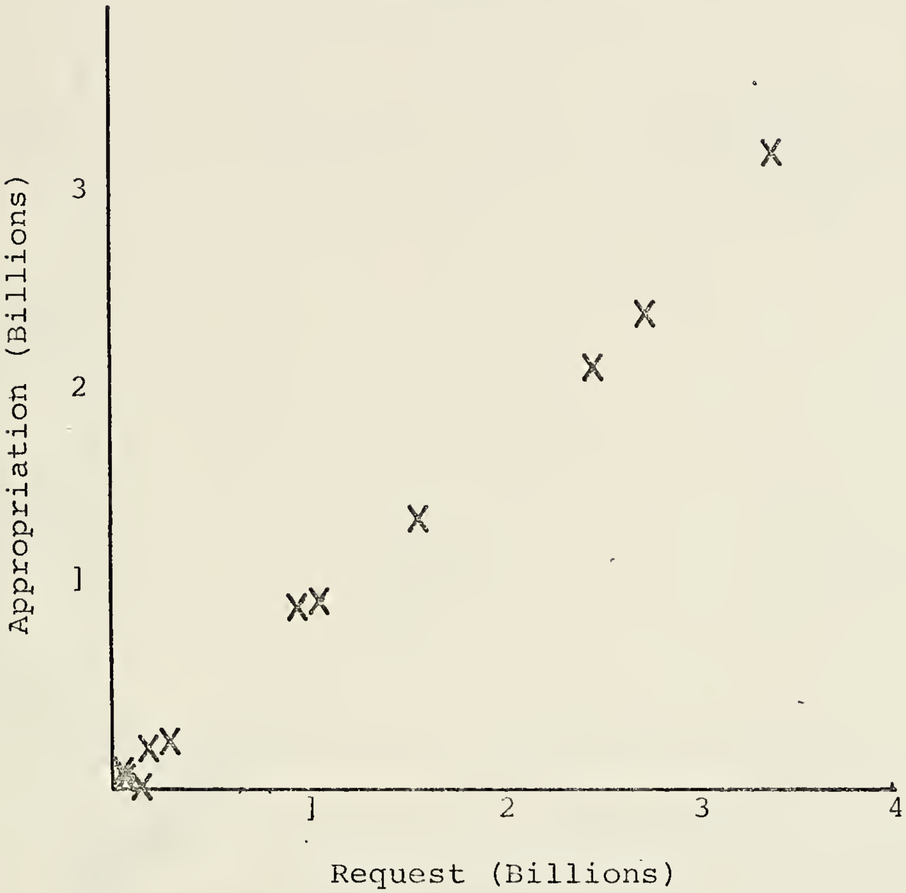
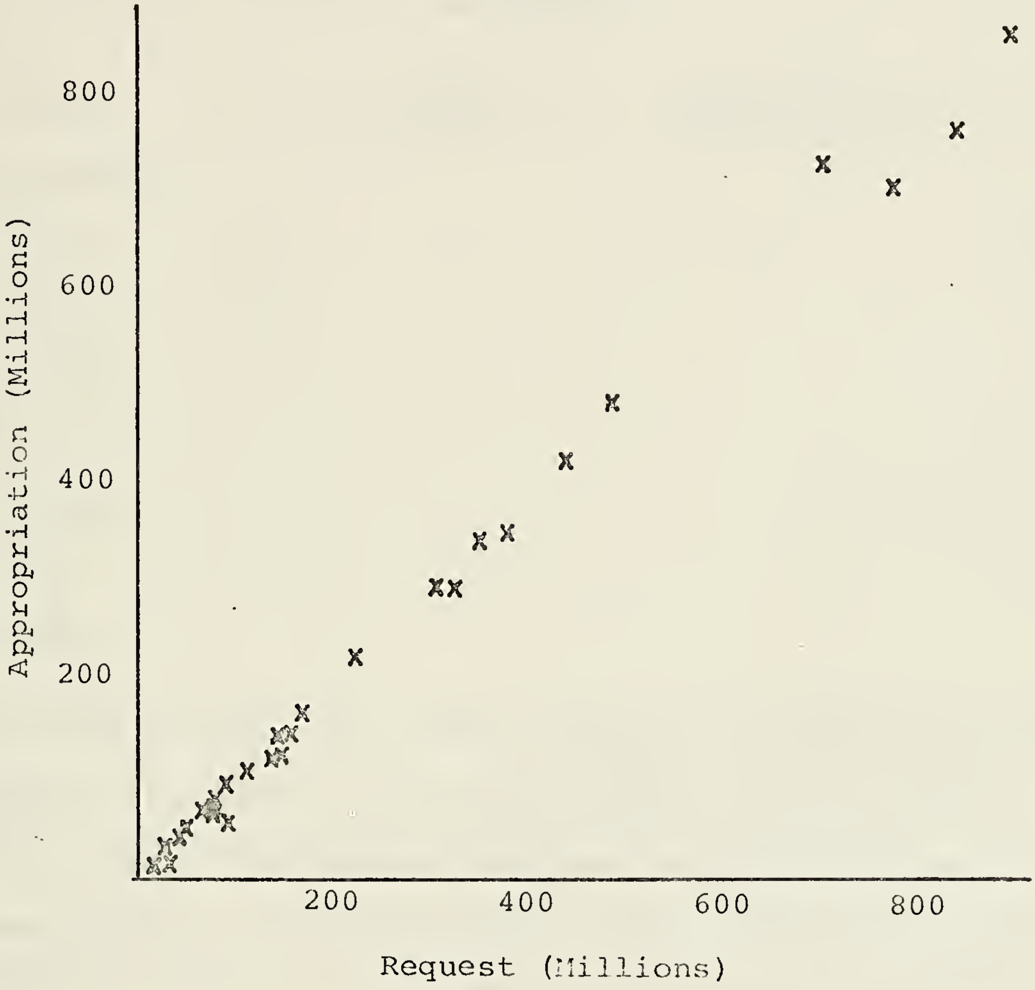


FIGURE III-4

RDTE 1971



multiple and step-wise linear regression were used for computational ease. The programs were modified to suppress the constant term and generate the required coefficients and accompanying output to support comparisons among coefficients and models.

The test runs were organized in the following manner (an "x" means the model was tested):

Model	A	B	B(Program)	C	C(Authorization)	D	D(Program)
Procurement							
1970	x	x			x		x
1971	x	x		x	x		x
1973	x	x			x		x
RDTE							
1970	x						
1971	x	x	x	x		x	x
1973	x		x				x

As stated earlier, the primary sources for appropriation and request data used in testing the models were the spread sheets used by the Senate Committee on Armed Services.[2] These sources were corroborated by the others mentioned and thought to be the most accurate documentation available of

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[2] Recent studies by E. Laurance (Naval Postgraduate School) have shown an emerging dominance of the Senate Committee on Armed Services in determining RDTE and Procurement appropriations.

Congressional appropriation behavior. Except where noted, the models were tested using appropriation and request data from these spread sheets. With the idea that subcommittee members might desire to use only a single spread sheet (for simplicity) and be interested in the most current data, substitutions of authorization and program data were used for previous year request and appropriation where spread sheets tabled these figures and not prior year requests and appropriations. For example, RDTE [Ref. 24] summarized current year request and appropriation but indicated current year program (last years appropriation modified by reprogramming) rather than prior year appropriation. In this case, it did not seem unreasonable to assume that current year program was a good substitute for prior year appropriation. Similarly, Procurement [Ref. 24] reported prior year authorization rather than prior year request.

The suggested models were then run as described earlier with the constant term suppressed. In the following section, results will be presented. Particular attention will be paid to the appropriateness of certain statistics generated by the BIOMED programs and their use in model evaluation and comparison.

IV. EMPIRICAL RESULTS

The four suggested models were first placed in a reduced form compatible with the multiple-linear regression programs used for actual testing. As they appeared in their structural form, the models were

$$\text{MODEL A:} \quad Y_t = B_1X_t + \varepsilon$$

$$\text{MODEL B:} \quad Y_t = B_1Y_{t-1} + B_2(X_t - B_1Y_{t-1}) + \varepsilon$$

$$\text{MODEL C:} \quad Y_t = B_1X_{t-1} + B_2(X_t - B_1X_{t-1}) + \varepsilon$$

$$\text{MODEL D:} \quad Y_t = B_1Y_{t-1} + \varepsilon$$

Model A and D, as stated, were in their reduced form. Model B and C required the following calculation:[1]

$$\begin{aligned} \text{MODEL B:} \quad Y_t &= B_1Y_{t-1} + B_2(X_t - B_1Y_{t-1}) + \varepsilon \\ &= B_2X_t + B_1Y_{t-1} - B_2B_1Y_{t-1} + \varepsilon \\ &= B_2X_t + B_1(1 - B_2)Y_{t-1} + \varepsilon \\ &= a_1X_t + a_2Y_{t-1} + \varepsilon \end{aligned}$$

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[1] Calculation is shown only for Model B but calculation for C is similar.

The four reduced form models were

MODEL A: $Y_t = a_1 X_t + \varepsilon$

MODEL B: $Y_t = a_1 X_t + a_2 Y_{t-1} + \varepsilon$

MODEL C: $Y_t = a_1 X_t + a_2 X_{t-1} + \varepsilon$

MODEL D: $Y_t = a_1 Y_{t-1} + \varepsilon$

These models were then run in accordance with Table I which again outlines the cross-sectional analysis possible within the existing data base. The BIOMED multiple linear regression package was used in the suppressed constant mode to evaluate the relevant estimated coefficients for each model. The resulting coefficients are shown in Table II. In terms of the incremental (or percentage) significance attached to the values of the coefficients, they all seemed plausible with the possible exception of the -0.0442 value of a_2 evaluated in the 1970 Procurement B Model and the 1.082 value of a_1 evaluated in the 1973 RDTE D(Program) Model. The latter was readily explained by a study of the data which revealed a significant increase in DOD RDTE funds in 1973 over those appropriated in 1972. The former figure was explained by an investigation of the significance of the coefficients in each model using a two-tailed "t" test at the .05 level to test the null hypothesis $a_i = 0$ (that the coefficients were not statistically different than zero).

TABLE I

TEST RUNS

MODEL	A	B	B(A)	C	C(A)	D	D(P)
PROCUREMENT							
1970	x	x			x	x	
1971	x	x		x	x	x	
1973	x	x			x	x	
RDTE							
1970	x						
1971	x	x	x	x		x	x
1973	x		x				x

TABLE II

REDUCED FORM COEFFICIENTS

MODEL	A	B	B(A)	C	C(A)	D	D(P)
PROCUREMENT							
1970	$a_1=.8867$	$a_1=.9263$ $a_2=-.0442$*			$a_1=.8704$ $a_2=.0154$*	$a_1=.9451$	
1971	$a_1=.9120$	$a_1=.7087$ $a_2=.2151$		$a_1=.7823$ $a_2=.1223$*	$a_1=.6799$ $a_2=.2169$	$a_1=.8830$	
1973	$a_1=.8068$	$a_1=.5437$* $a_2=.2929$*			$a_1=.6369$* $a_2=.1817$*	$a_1=.8967$	
RDTE							
1970	$a_1=.9041$						
1971	$a_1=.9673$	$a_1=.8806$ $a_2=.0845$[1]	$a_1=.8601$ $a_2=.1056$*	$a_1=.9612$ $a_2=.0056$*[1]		$a_1=.9015$	$a_1=.9304$
1973	$a_1=.9479$		$a_1=.8532$ $a_2=.1137$*			$a_1=1.0820$	

[1] Only 21 data points used

The test statistic was formed by taking the quotient of the value of the coefficient and its standard error and comparing it to the tabled value of t corresponding to the .05 level and the appropriate degrees of freedom. A test value smaller than the tabled value indicated the null hypothesis could not be rejected at the .05 level.[2] In accomplishing this test, those coefficients indicated by an asterisk (*) in Table II were found to be statistically insignificant. The value of a_2 in the B Model Procurement 1970 was among those found insignificant.

The results of this test also revealed an apparent inconsistency in the 1973 Procurement Models B and C (Authorization) where both coefficients in each model were apparently statistically insignificant. This was particularly notable since corresponding models in 1970 and 1971 have at least one coefficient which is significant. In fact, the apparent inconsistency is attributable to a multicollinearity effect which surfaced in the B and C (Authorization) models in 1973. Multicollinearity among independent variables usually manifests itself in high correlations in the printed correlation matrix of a tested model or in unusually high jumps in the standard error of coefficients upon the addition of another variable to the regression. The

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[2] See Theil [Ref. 25, p. 138] and Military Equipment Cost Analysis [Ref. 23, p. 47-50] for a detailed discussion of this test.

latter result, demonstrated in the B and C(A) Models, is an indication that current year budget requests and prior year appropriation or prior year request were so highly correlated[3] that matrix inversion (used to solve for the coefficients) was unstable.[4] Although high correlation matrices were noted in other tested models, the correlations were not high enough to affect any other calculations.

The reduced form estimated coefficients were then transformed into structural model estimated coefficients by a substitutiveprocess. Of course, the single variable models required no transformation. A sample of the two-variable transformation is shown below[5] and the structured coefficients are contained in Table III.

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[3] This is not surprising since according to Dempster, Davis, and Wildavsky, agency requests are a simple linear function of prior year appropriation [Ref. 5].

[4] In order to invert a matrix, in this case the correlation matrix, the matrix must be non-singular (full rank). If correlations among variables are high enough, the computer routines will try to invert a singular matrix and unstable results will occur.

[5] MODEL B: Structured Form: $Y_t = \hat{B}_1 Y_{t-1} + \hat{B}_2 (X_t - \hat{B}_1 Y_{t-1}) + \varepsilon$

Reduced Form: $Y_t = a_1 X_t + a_2 (Y_{t-1}) + \varepsilon$

$$a_1 = .7087$$
$$a_2 = .2131$$
$$a_1 = \hat{B}_2 = .7087$$
$$a_2 = \hat{B}_1 (1 - \hat{B}_2)$$
$$a_2 = .2151 = \hat{B}_1 (.2913)$$
$$\hat{B}_1 = \frac{.2151}{.2913}$$
$$Y_t = .739\ Y_{t-1} + .2151\ (X_t - .739 Y_{t-1}) + \varepsilon$$

Note: These estimated coefficients are consistent in a statistical sense, but are not necessarily unbiased [Ref. 25 Chpt.6].

TABLE III

STRUCTURED FORM COEFFICIENTS

MODEL	A	B	B(A)	C	C(A)	D	D(P)
PROCUREMENT							
1970	$\hat{B}_1=.8867$	$\hat{B}_1=-.6000$			$\hat{B}_1=.1190$	$\hat{B}_1=.9451$	
		$\hat{B}_2=.9260$			$\hat{B}_2=.8704$		
1971	$\hat{B}_1=.9120$	$\hat{B}_1=.7390$		$\hat{B}_1=.5650$	$\hat{B}_1=.6790$	$\hat{B}_1=.8830$	
		$\hat{B}_2=.7087$		$\hat{B}_2=.7823$	$\hat{B}_2=.6800$		
1973	$\hat{B}_1=.8068$	$\hat{B}_1=.6460$			$\hat{B}_1=.6900$	$\hat{B}_1=.8960$	
		$\hat{B}_2=.5437$			$\hat{B}_2=.6369$		
RDTE							
1970	$\hat{B}_1=.9041$						
1971	$\hat{B}_1=.9673$	$\hat{B}_1=.7060$	$\hat{B}_1=.7590$	$\hat{B}_1=.1932$		$\hat{B}_1=.9015$	$\hat{B}_1=.9304$
		$\hat{B}_2=.8806$	$\hat{B}_2=.8601$	$\hat{B}_2=.9612$			
1973	$\hat{B}_1=.9479$		$\hat{B}_1=.7750$				$\hat{B}_1=1.0820$
			$\hat{B}_2=.8530$				

In evaluating the fit of the models to the data, the greater the dispersion of the observed values of Y_t (the current year appropriation) about the generated line, the less accurate the estimates of Y_t that are based on that line are likely to be. In this respect, discussion of the respective fits of the four models to their data will center on two measures of dispersion: an adjusted coefficient of determination ($\overline{R}^2$) and the coefficient of variation (CV). The reason for this two fold approach is the difference in the two measures. Both are indicators of dispersion but $\overline{R}^2$ is based on a proportion and the coefficient of variation is based on an absolute quantity (the standard error of the estimate). See Figure IV-1. As such, even if the explained variance represented a high fraction of the total variance, it would be possible for the unexplained variance to be large relative to the estimated $\hat{Y}_i$ (current year predicted appropriation).

For these reasons, the adjusted coefficient of determination ($\overline{R}^2$) and the coefficient of variation (CV) were used as measures of model fit to the given data.

The suppressed constant model, as an option in the BIOMED series of multiple-linear regression models computes all variances, covariances, standard deviations, and correlations about the origin rather than the mean. As such, this model, using a proportional measure of fit such as $\overline{R}^2$, will overstate

FIGURE IV-1

$$\bar{R}^2 = \frac{\text{Explained Variance}}{\text{Total Variance}}$$

$$CV = \frac{\sqrt{\text{Unexplained Variance}}}{\bar{Y}}$$

Where:

Y_i = Observed appropriation

$\bar{Y}$ = Mean value of the observed appropriation

$\hat{Y}_i$ = Predicted value of an appropriation.

n = Number of observations of Y_i

k = Number of degrees of freedom

$$\text{Total Variance} = \frac{\Sigma(Y_i - \bar{Y})^2}{n-1}$$

$$\text{Explained Variance} = \frac{\Sigma(\hat{Y}_i - \bar{Y})^2}{n-k}$$

$$\text{Unexplained Variance} = \frac{\Sigma(Y_i - \hat{Y}_i)^2}{n-k}$$

$\sqrt{\text{Unexplained Variance}}$ = Standard Error (SE) of the estimate

the fit of the line to the data.[6] Consequently, it was necessary to calculate, separately, the total variance figure in order to apply the formula for $\bar{R}^2$. Using the proper computed total variance, $\bar{R}^2$ was calculated and placed into Table IV.

In comparing the standard errors of the estimates (SE) for each model, the coefficient of variation (CV) was used. As previously described, the coefficient of variation is

$$CV = \frac{SE}{\bar{Y}}$$

In a sense, the SE is weighted by its respective $\bar{Y}$ to make comparisons among standard errors more relevant. Ideally, the smaller the CV for a given model, the more reliable is the estimate. Although no set figures have been given, percentages no greater than 20% are generally considered acceptable fits [Ref. 23, p. 44].

The appropriate statistics for the CV calculation were gathered for each model and the corresponding CV figures were placed into Table V.

With the test runs, estimated coefficients for the reduced and structural models, and appropriate measures of

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[6] $\bar{R}^2$ may also be stated as $\bar{R}^2 = 1 - \frac{\text{Unexplained Variance}}{\text{Total Variance}}$. Using this form, it is easily seen why computing total variance about zero will overstate the fit of a line to the data.

TABLE IV

ADJUSTED COEFFICIENT OF DETERMINATION ($\overline{R}^2$)

MODEL	A	B	B(A)	C	C(A)	D	D(P)
PROCUREMENT							
1970	$\overline{R}^2=.9819$	$\overline{R}^2=.9802$			$\overline{R}^2=.9798$	$\overline{R}^2=.7481$	
1971	$\overline{R}^2=.9962$	$\overline{R}^2=.9990$		$\overline{R}^2=.9971$	$\overline{R}^2=.9978$	$\overline{R}^2=.9650$	
1973	$\overline{R}^2=.9840$	$\overline{R}^2=.9834$			$\overline{R}^2=.9831$	$\overline{R}^2=.9817$	
RDTE							
1970	$\overline{R}^2=.9293$						
1971	$\overline{R}^2=.9957$	$\overline{R}^2=.9955$	$\overline{R}^2=.9963$	$\overline{R}^2=.9944$		$\overline{R}^2=.8986$	$\overline{R}^2=.9956$
1973	$\overline{R}^2=.9906$		$\overline{R}^2=.9914$				$\overline{R}^2=.9103$

TABLE V

COEFFICIENT OF VARIATION

MODEL	A	B	B(A)	C	C(A)	D	D(P)
PROCUREMENT							
1970	CV=.1353	CV=.1416			CV=.1433	CV=.5051	
1971	CV=.1210	CV=.1233		CV=.0522	CV=.1244	CV=.1811	
1973	CV=.0831	CV=.0427			CV=.0646	CV=.1810	
RDTE							
1970	CV=.2528						
1971	CV=.0670	CV=.0570	CV=.0629			CV=.2688	CV=.2162
1973	CV=.1065		CV=.1022				CV=.3286

model fit summarized in Tables I-V, it was then possible to address the appropriateness of the models as explanations of Congressional appropriation behavior toward DOD budget requests and to comment further on Dempster, Davis, and Wildavsky's contention that DOD can be modeled as any other federal agency. Discussion of these points follows in Chapter V - Analysis and Significance of Results.

V. ANALYSIS AND SIGNIFICANCE OF RESULTS

A. ANALYSIS OF RESULTS

Robert R. Brown in Explanation in Social Science stated that explanation "seeks to remove impediments" [Ref. 1, p. 41]. To this end, the tested models (or decision rules) have at least partially explained the behavior of Congress in the complex DOD budgeting process. In the reported proprtional and absolute measures of fit for each rule (see Tables IV and V), very little variance in a proportional and absolute sense was left unexplained. The data used in the D Model (Procurement) (using prior year appropriation to explain a current year appropriation) in 1970 did give unfavorable results, but an analysis of the programs contained in the budget categories reflected program deletions of an unusually large magnitude (i.e. the dropping of the Army Cheyene Helicopter, the Navy A-7E, and the Navy Fast Deployment Logistics Ship (FDL)) which might have accounted for the poor overall fit of the data to the model. What is significant in the fact that decision rules generally fit the data very well is the indication that a seemingly complex process can be at least partially explained by a few simple, linear decision rules.

This fact is more significant when it is realized that the postulated models (or decision rules) were not the result of a "data crunching" exercise to determine a "best fit" model. The models were formulated based on observed interaction between agency and Congress and the documented success

of Dempster, Davis, and Wildavsky in using similar models in analyzing non-defense federal budgetary behavior. As such, the results are one more addition to a growing line of literature documenting Congressional use of simple decision rules in non-defense and defense budgeting. It is also significant to note that Dempster, Davis, and Wildavsky found the A Model (using current year request to explain current year appropriation) to be the best fit for their data. In this analysis, the A Model was also found to be the best fit for the data. This fact again supports the Congressional use of simple, linear decision rules throughout non-defense and defense budget processes (a fact suggested by Dempster, Davis, and Wildavsky in their studies [Ref. 2, p. 301].

Perhaps the most striking significance of the results is the inherent difference in non-defense and defense appropriations. Results, as indicated in the A Model of this analysis were roughly comparable to those achieved by Dempster, Davis, and Wildavsky in their studies. Yet, unlike non-defense appropriations which authorize expenditure for a single year in a program that is quite stable, Procurement and RDTE appropriations involve obligational authority to programs which vary from year to year and obligational authority which varies in length from two to five years. In this light, there is no real reason to believe, as there might be with annual operating accounts, that simple, linear models would fit the data as well as discovered.

In general then, the proposed simple, linear decision rules seem to have considerable explanatory power in revealing Congressional behavior toward budget requests. This view is strengthened by the use of verbal theory (outlined in the efforts of Wildavsky and Fenno) and the results of Dempster, Davis, and Wildavsky's studies of non-defense federal budgetary behavior in formulating the models. And, finally the significance of the successful application of the models is enhanced by the fact that Procurement and RDTE programs change constantly and appropriations involve multi-year obligations of funds.

B. AREAS FOR FURTHER ANALYSIS

Cross-sectional analysis was used exclusively in this study. As such, the coefficients, designed to be interpreted as percentage figures, only reflect budgetary behavior for either Procurement or RDTE in a particular year. These figures might reveal overall budget behavior but they reveal little about what is going on in any single category such as military sciences (ARMY) or aircraft procurement (ARMY). To determine what is going on in a particular category it would be necessary to collect data for that category for a longer period of time (say 10-15 years) and do a time series analysis. In a cross-sectional analysis, a study of the residuals for each year will identify those categories which least fit the model, but a detailed analysis of residuals is necessary to reveal any specific rules which might be

applicable to a specific category.[1] Such time series or cross-sectional analysis would reveal pecularities of a particular category which might be interesting to DOD "agencies" responsible for that particular budget request.

Still, cross-sectional analysis with available data did reveal certain budget behavior in the four year period covered. First, the single variable (Model A) produced better data fit in each year and also produced more consistent (and believable) coefficients for each year studied. While Model D produced coefficients of comparable consistency to those produced in Model A and in general explained much of the variance (see Table IV), the absolute measure of fit for each year with these models was considerably worse than the other models (which were primarily a function of current year request - not prior year appropriation) (see Table V). Significant also is the lack of any discernible pattern in the coefficients reported for each successive year using multi-variable decision rules (see Table III). These views suggest that A Model, the simplest of all models, also possesses the greatest explanatory power. The failure of the more complex models to produce consistent (or believable) coefficients is perhaps an indication that Congressional behavior is manifested in a two stage process. The first, a very simple decision rule to roughly determine the

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[1] No particular patterns of residuals were noticed in analyzing the given data; but a thorough investigation of residuals was not conducted.

particular cut for a given year and second, the presence of a more complex procedure (which may or may not be explained by an analytical model) to determine where particular cuts will be made once the general decision rule has been applied. Further analysis is needed in this area.

Model A appears to possess the greatest explanatory power of any model tested in this analysis. As such, information which can be derived or otherwise taken from the coefficient generated is of considerable importance in the analysis. For each year, the coefficient in the A Model describes a general rule — not associated with any one particular category but representative of all categories in either Procurement or RDTE in that year. Ideally, the coefficient should remain stable over a period of years. For example, coefficients in the A Model, particularly in RDTE appear somewhat stable over the years covered (a= .904, a= .967, a= .948). But, there was quite a difference in the size of the Procurement coefficient in 1971 and 1973 (a= .912 in 1971 and a= .8068 in 1973). Further research is also needed in this area of coefficient stability.

A possible avenue for further research in coefficient stability and other topics presented itself when Model D (current year appropriation as explained by prior year appropriation) was examined. When consecutive year cross-sectional analysis is accomplished, the resulting coefficient ignores any impact of prior year appropriation on current year request. That Model D fits the data at all is

evidence that prior year appropriation is somehow related to current year request. This leads one to suspect that the analysis contained in this thesis has perhaps considered only half the problem. In a consecutive year study, current year appropriation (as an indication of Congressional budgetary behavior) appears to impact on the following year budget request. Before any significance can be attached to numerical stability or instability of coefficients generated from year to year, perhaps a detailed analysis of "account" behavior should be accomplished. Should similar models be formulated to explain account behavior and should the decision rules fit the data as well as the models in this analysis, several significant conclusions might be drawn. First, coefficient stability or instability for the Congress may be related to what decision rules the agency has been using in formulating its request. Second, if decision rules for both the Congress and the agency were known, DOD would be better able to predict budget requests which would most likely fit Congressional decision rules. Of course, Congress would be in the same position. There is evidence (notably in the Committee and Sub-Committee Hearings on Defense and studies of Dempster, Davis, and Wildavsky in non-defense) to suggest that such a "give and take" procedure already exists, but the formalization of the process in analytic terms could significantly aid DOD in the continuation or selection of certain high dollar programs. Finally, if this two model theory were to work, it would have significant implications

for the question of Presidential influence since the decision rules basically involve only actions of Congress and DOD.

C. SUMMARY

Increasing Congressional influence on DOD expenditures, particularly in Procurement and RDTE 1969-1973 [Ref. 18], suggested and supported this study of Congressional budget behavior toward DOD requests. A detailed chronology of the DOD budget cycle and a survey of the work of Wildavsky and Fenno in Congressional budgetary behavior suggested Congressional use of simple, stable decision rules in determining appropriations for DOD budget requests. Four mathematical models were designed to express the simple and stable Congressional decision rules suggested by Wildavsky and Fenno. The models were also designed to be consistent with Wildavsky's and Fenno's observations of a base figure and incrementalism in Congressional appropriations behavior. The models were then tested at an appropriate account level with RDTE and Procurement data in the 1970-1973 time frame. Proportional and absolute measures of explained and unexplained variance were used to make statements about model fit to the data.

In terms of these measures, it appears that at least part of a complex DOD budgetary process can be explained by these simple mathematical models. In addition, the success of these models has suggested deeper analysis into specific Congressional behavior toward particular DOD budget categories.

Finally, the results suggested the idea of a game theoretic approach to DOD budgeting where both DOD and Congress act like opponents in a two-player game and adjust their requests and appropriations based on observation of each other's behavior.

APPENDIX A

DATA SUMMARIES

- Procurement
  - Aircraft
    - Army (1)
    - Navy and Marine Corps (2)
    - Air Force (3)
  - Missiles
    - Army (4)
    - Navy (5)
    - Marine Corps (6)
    - Air Force (7)
  - Navy Vessels (8)
  - Tracked Combat Vehicles
    - Army (9)
    - Marine Corps (10)
  - Other Weapons[1]
    - Army (11)
    - Navy (12)
    - Marine Corps (13)
  - Torpedoes[2] (14)

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[1] Category initiated in 1971.

[2] Category initiated in 1973.

APPENDIX A

DATA SUMMARIES[*]

Procurement 1970	Y_t	X_t	Y_{t-1}	X_{t-1} (Authorization)
Aircraft				
(1)	554,400	941,500	735,247	735,447
(2)	1,826,200	2,409,200	2,311,284	2,406,988
(3)	3,730,800	4,100,200	4,460,000	5,212,000
Missiles				
(4)	831,900	957660	908,040	956,140
(5)	818,800	851,300	673,016	848,212
(6)	3,400	20,100	13,500	13,500
(7)	1,448,100	1,486,400	1,720,200	1,768,000
Navy Vessels				
(8)	2,490,300	2,631,400	820,700	1,581,500
Tracked Combat Vehicles				
(9)	201,100	305,800	286,826	299,426
(10)	37,700	37,700	10,800	10,800
Other Weapons				
(11)				
(12)				
(13)				
Torpedoes				
(14)				

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[*] Data in thousands of dollars.

Procurement 1971	Y_t	X_t	Y_{t-1}	X_{t-1}
				(Authorization)
Aircraft				
(1)	254,600	296,900	554,400	570,400
(2)	2,126,500	2,487,700	1,826,200	2,391,200
(3)	3,219,500	3,374,300	3,730,800	3,965,700
Missiles				
(4)	983,800	1,094,600	831,900	880,460
(5)	905,500	983,000	818,800	851,300
(6)	12,800	27,600	3,400	20,100
(7)	1,377,200	1,544,600	1,448,100	1,486,400
Navy Vessels				
(8)	2,465,400	2,728,900	2,490,300	2,983,200
Tracked Combat Vehicles				
(9)	197,500	207,200	201,100	228,000
(10)	47,400	48,700	37,700	37,700
Other Weapons				
(11)	62,000	69,200		
(12)	2,789	2,789		
(13)	4,400	4,400		
Torpedoes				
(14)				

Procurement 1973	Y_t	X_t	Y_{t-1}	X_{t-1} (Authorization)
Aircraft				
(1)	33,500	162,900	90,400	94,200
(2)	2,822,100	3,276,200	3,154,900	3,254,900
(3)	2,239,300	3,255,700	2,899,000	3,029,800
Missiles				
(4)	668,200	896,700	940,820	1,066,100
(5)	719,240	842,400	700,100	704,100
(6)	22,100	22,100	1,300	1,300
(7)	1,670,000	1,816,800	1,633,700	1,791,200
Navy Vessels				
(8)	2,970,600	3,564,300	3,005,200	3,067,100
Tracked Combat Vehicles				
(9)	130,500	260,700	112,500	112,500
(10)	54,500	62,200	63,900	63,900
Other Weapons				
(11)	56,300	114,400	33,000	33,000
(12)	25,700	25,700	1,300	1,300
(13)	900	900	1,000	1,000
Torpedoes				
(14)	192,400	194,200	193,500	193,500

Research, Development, Test, and Evaluation	
Army	
Military Sciences	(1)
Aircraft and Related Equipment	(2)
Missiles and Related Equipment	(3)
Military Astronautics	(4)
Ordnance, Combat Vehicles, and Related Equipment	(5)
Other Equipment	(6)
Programwide Management and Support	(7)
Navy	
Military Sciences	(8)
Aircraft and Related Equipment	(9)
Missiles and Related Equipment	(10)
Military Astronautics	(11)
Ships and Small Craft Related Equipment	(12)
Ordnance, Combat Vehicles, and Related Equipment	(13)
Other Equipment	(14)
Programwide Management and Support	(15)
Air Force	
Military Sciences	(16)
Aircraft and Related Equipment	(17)
Missiles and Related Equipment	(18)
Military Astronautics	(19)
Ordnance, Combat Vehicles, and Related Equipment	(20)
Other Equipment	(21)
Programwide Management and Support	(22)
Defense Agencies[1]	
Military Science	(23)
Missiles and Related Equipment	(24)
Other Equipment	(25)
SADA	(26)
ARPA	(27)
DASA	(28)
Other	(29)

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[1] Categories in this area vary considerably from year to year; categories listed appear to be the most stable and representative since 1969.

RDTE 1970	Y_t	X_t	Y_{t-1}(Program)
Army			
(1)	163,300	182,400	
(2)	71,500	127,100	
(3)	897,400	914,900	
(4)	10,000	14,000	
(5)	163,000	193,000	
(6)	350,600	363,400	
(7)	48,100	54,100	
Navy			
(8)	139,800	160,100	
(9)	799,700	577,300	
(10)	459,300	564,600	
(11)	19,700	24,000	
(12)	291,500	345,200	
(13)	95,800	109,100	
(14)	252,900	280,000	
(15)	141,200	151,200	
Air Force			
(16)	136,400	158,700	
(17)	608,900	663,000	
(18)	912,900	976,900	
(19)	751,700	1,068,000	
(20)	-------	-------	
(21)	349,200	385,200	
(22)	301,200	309,400	
Defense Agencies			
(23)	-------	-------	
(24)	-------	-------	
(25)	-------	-------	
(26)	9,000	10,500	
(27)	212,100	238,100	
(28)	112,000	124,000	
(29)	116,900	127,600	

RDTE 1971	Y_t	X_t	Y_{t-1}(Program)
Army			
(1)	166,600	176,200	162,700
(2)	106,200	110,200	95,600
(3)	869,000	896,400	853,500
(4)	8,500	10,700	9,300
(5)	144,900	153,200	153,500
(6)	297,800	317,800	303,300
(7)	52,300	52,300	51,500
Navy			
(8)	135,300	142,200	139,300
(9)	735,800	694,000	794,800
(10)	484,600	494,300	458,700
(11)	28,100	29,100	19,100
(12)	350,200	377,500	296,500
(13)	89,000	89,000	100,400
(14)	223,400	226,700	242,200
(15)	143,000	144,500	148,600
Air Force			
(16)	134,300	134,600	136,400
(17)	765,700	831,300	708,200
(18)	708,300	762,800	907,400
(19)	437,700	437,700	642,400
(20)	78,300	78,300	69,100
(21)	357,400	359,600	302,700
(22)	305,400	305,400	314,300
Defense Agencies			
(23)	69,000	77,900	63,600
(24)	66,000	66,000	65,000
(25)	78,300	78,800	87,500
(26)	23,900	26,900	24,800
(27)	44,600	44,600	46,000
(28)	67,100	67,100	66,000
(29)	80,000	83,100	76,100

NOTE: In this year (26), (27), (28), and (29) respectively referred to DCA, DASA (Military Sciences), DASA (Other Equipment), and NSA.

RDTE 1973	Y_t	X_t	Y_{t-1}(Program)
Army			
(1)	181,000	205,500	186,000
(2)	185,000	255,100	168,000
(3)	888,500	990,300	896,900
(4)	18,900	18,900	10,800
(5)	188,100	197,100	178,700
(6)	384,700	397,000	348,100
(7)	58,900	58,900	62,200
Navy			
(8)	135,400	154,100	143,600
(9)	367,900	384,900	609,400
(10)	904,600	1,026,300	520,900
(11)	89,800	99,800	43,000
(12)	451,600	430,200	411,300
(13)	44,800	44,800	60,000
(14)	507,000	517,500	440,700
(15)	159,100	159,100	152,900
Air Force			
(16)	131,300	146,300	142,700
(17)	1,302,900	1,343,100	1,181,300
(18)	392,400	415,400	410,100
(19)	349,300	350,700	341,100
(20)	100,600	100,600	92,500
(21)	597,800	522,000	404,400
(22)	384,200	384,200	349,300
Defense Agencies			
(23)	60,000	60,000	55,700
(24)	78,600	78,600	71,900
(25)	70,600	84,400	78,600
(26)	13,200	13,900	26,000
(27)	12,300	12,900	13,400
(28)	17,300	17,300	14,200
(29)	------	------	------

NOTE: In this year (26), (27), and (28) respectively referred to DCA, DSA, and Technical Support to OSD/OJCS.

BIBLIOGRAPHY

1. Brown, R.B., Explanation in Social Science, Aldine Publishing Company, Chicago, 1963.

2. Byrne, R.F., and others (eds.), Studies in Budgeting, p. 292-321, North-Holland Publishing Company, 1971.

3. Congressional Action on FY-- Budget Request by Appropriation Title and Item, Department of Defense Appropriation Bill, Office of Assistant Secretary of Defense (Comptroller) (Fiscal years 1971-1973 available for all budget categories).

4. Crecine, J.P. and Fischer, G., On Resource Allocation Processes in the U.S. Department of Defense, an Institute of Public Policy Studies Discussion Paper No. 31, October, 1971.

5. Davis, O.A., Dempster, A.H., and Wildavsky, A., "A Theory of the Budgetary Process," The American Political Science Review, v. 60, p. 529-547, September, 1966.

6. Department of Defense Appropriations, Research, Development, Test and Evaluation (Part 4) and Procurement (Part 7), Hearings before a Subcommittee of the Committee on Appropriations House of Representatives, U.S. Government Printing Office, Washington: 1972. (volumes from 1962-1973 used for this study)

7. Department of Defense Appropriations, Part 3: Department of the Navy, Senate Hearings before the Committee on Appropriations, U.S. Government Printing Office, Washington: 1972. (volumes from 1962-1973 used for this study)

8. Dixon, Wilfred J. and Massey, Frank J., Jr., Introduction to Statistical Analysis, p. 193-215, McGraw-Hill Book Company, New York, 1969.

9. Draper, Norman and Smith, Henry, Applied Regression Analysis, John Wiley and Sons, Inc., New York, 1966.

10. Enke, Stephen, Defense Management, Prentice Hall, Inc., New Jersey, 1967.

11. Executive Office of the President: Bureau of the Budget, Subject: Preparation and Execution of the Federal Budget, April, 1966.

12. Fenno, R.F. Jr., "The House Appropriations Committee as a Political System: The Problem of Integration," *The American Political Science Review*, v. 56, p. 310-324, June, 1962.

13. Fenno, R.F., Jr., *The Power of the Purse: Appropriation Politics in Congress*, Little, Brown and Company, Boston, 1966.

14. Harris, Joseph P., *Congressional Control of Administration*, The Brookings Institution, Washington, D.C., 1964.

15. Hoel, Paul G., Port, Sidney C., and Stone, Charles J., *Introduction to Statistical Theory*, p. 111-157, Houghton Mifflin Company, Boston, Mass. 1971.

16. Johnson, R.W., *A Model of Federal Agency Budgetary Behavior: Agency Requests as a Function of Environmental Constraints*, paper prepared for 1972 Annual Meeting of the *Public Choice Society*, May 3-6, 1972.

17. Kanter, A., "Congress and the Defense Budget 1960-1970," *The American Political Science Review*, v. 66, p. 129-143, March, 1972.

18. Korb, Lawrence J., "Congressional Impact on Defense Spending, 1962-1973: The Programmatic and Fiscal Hypotheses," Prepared for delivery at the 1973 annual meeting of the American Political Science Association, Jung Hotel, New Orleans, Louisiana, September 4-8. Copyright, 1973, The American Political Science Association.

19. Lyden, F.J., and Miller, E.G., *Planning, Programming, Budgeting*, Markham Publishing Company, Chicago, Ill., 1972.

20. Navy Comptroller, *Report of Programs (C)*: DD Form 1416 (FY 1972), 31 December 1972.

21. NAVSO P-2457 (Rev. 7-72), *Department of the Navy RDTE Management Guide, Part I: System Description*, July, 1972.

22. Novick, David (ed.), *Program Budgeting*, Holt, Rinehart and Winston, Inc., New York, 1969.

23. Rand Corporation, *Military Equipment Cost Analysis*, p. 33-77, Santa Monica, California, June, 1971.

24. *Summary of Fiscal Year DOD Authorization and Appropriations*, Printed for use of Senate Committee on Armed Services, Committee Print Table (Fiscal years 1970, 1971, and 1973 for Procurement and RDTE available).

25. Theil, Henri, Principles of Econometrics, John Wiley and Sons, Inc., New York, 1971.

26. Wildavsky, A., The Politics of the Budgetary Process, Little, Brown, and Company, Boston, 1964.

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A methodology based on the current Department of Defense budgetary process and recent efforts to model federal budgetary behavior is proposed for analyzing Congressional behavior toward Department of Defense budget requests. Four simple, linear, stochastic models which associate Congressional appropriations with DOD budget requests are suggested and empirically tested via a cross-sectional regression analysis for

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Procurement and Research, Development, Test and Evaluation in the 1970-1973 time frame. Results of the tests are tabulated and discussed. Model strengths as well as weaknesses are evaluated based on proportional and absolute measures of model fit to the data. Areas for further analysis are also suggested.

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